

## **Characterizing Small Planets and Stellar Jitter with the Combination of K2 and HARPS-N**

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The Kepler mission has revealed that small planets are common. Although astronomers have measured the radii of many of these worlds to impressive precision by combining photometry with detailed characterization of planet host stars, the masses of the vast majority of small planets are completely unconstrained. There are only seven planets smaller than 2.5 Earth radii with published mass uncertainties smaller than 20%, the minimum value required to begin to discriminate between models of planet composition.

Our K2 Campaign 4 and 5 proposal is designed to significantly advance our understanding of the compositional diversity of small planets by tripling the number of small planets with well-constrained masses and radii. We propose to observe 8692 moderately bright stars with K2 to search for transiting planets. Based on occurrence rates measured using prime Kepler mission results, we anticipate that  $64 \pm 8$  small, short-period planets will transit our proposed stars during the campaigns and that  $35 \pm 6$  of those planets will be detectable by K2. We will search for those planets in the K2 pixel data using the light curve processing and planet detection pipeline developed by J. Johnson and A. Vanderburg. After performing an initial round of vetting tests based on the K2 photometry, we will acquire reconnaissance spectroscopy and imaging of promising planet candidates to identify the best targets for high-precision radial velocity (HPRV) observations. We anticipate conducting reconnaissance observations for  $28 \pm 5$  planet candidates and selecting  $14 \pm 4$  targets for HPRV observations.

We will conduct our HPRV observations using the HARPS-N spectrograph on the Telescopio Nazionale Galileo in La Palma, Spain. HARPS-N is an extremely stable, fiber-fed echelle spectrograph designed to measure radial velocities with exquisite precision. All of the members of our proposal team are members of the HARPS-N Consortium, which has 40 nights per year of guaranteed time specifically devoted to observations of small planets detected by Kepler and K2. PI D. Charbonneau is chair of the HARPS-N Science Team and the HARPS-N Target Selection Tiger Team.

We will deliver the following value added community resource products to the NASA archives: light curves and estimated stellar parameters for all targets; phase-folded light curves, reconnaissance imaging, and reconnaissance spectra for planet-candidate host stars; and tables of precise radial velocities for the subset of planet candidate host stars pursued by HARPS-N.

Our campaign to measure the masses of  $14 \pm 4$  small K2 planets with precision higher than 15% will have a tremendous impact on our understanding of small planets. By trebling the number of small planets with precise mass and radius estimates, we will enable investigations of the fraction of rocky planets as a function of planetary and stellar parameters such as orbital period, the presence of additional planets, and stellar metallicity. Improving our understanding of the relationship between the masses and radii of small planets will provide useful background information when selecting targets for atmospheric characterization with the James Webb Space Telescope and prioritizing the follow-up observations of planets detected by the Transiting Exoplanet Survey Satellite.